

REMARKS

Examiner Su Kim is thanked for the thorough examination and search of the subject Patent Application. Claims 8 and 10 have been amended and claim 9 has been canceled.

All Claims are believed to be in condition for Allowance, and that is so requested.

Reconsideration of the rejection under 35 U.S.C. 112, second paragraph, of Claims 9, 24, 35, and 45 as being indefinite for failing to particularly point out and distinctly claim the subject matter of the invention is respectfully requested in accordance with the following remarks.

It is believed that the specification of how to adjust the work function by controlling the contents of hafnium and nitride in the hafnium nitride composition is sufficiently given in the Specification at the bottom of page 6. The Specification states that the ratio of hafnium to nitrogen can be varied by changing the flow rate of the nitrogen gas through the vacuum chamber. The Specification further states that adjusting the hafnium to nitrogen ratio tunes the work function of the gate electrode. It is believed that this disclosure provides sufficient detail about how to adjust the work function of the gate electrode.

Reconsideration of the rejection under 35 U.S.C. 103(a) of Claims 8-9, 14, 24, 25-27, 35, 39, and 58 as being unpatentable over Haukka et al in view of Kraus et al is requested in view of amended Claim 8 and in accordance with the following remarks.

Claim 8 has been amended to incorporate the material from canceled claim 9: “wherein said depositing comprises flowing Nitrogen and Argon atoms into a chamber simultaneously wherein said chamber contains said substrate and a hafnium target.” The Examiner states that the combination of Haukka and Kraus discloses “said depositing of said hafnium nitride layer comprises flowing Nitrogen and argon atoms (paragraph 0038, an inactive gas) into a chamber simultaneously wherein said chamber contains said substrate and a hafnium target.” (Office Action, page 4).

However, Haukka et al teaches in paragraph [0038], lines 18-24: “Gas phase-reactions between precursors and any undesired reactions of byproducts are inhibited because material pulses are separated from each other by time and the reaction chamber is purged with an inactive gas (e.g. nitrogen or argon) between material pulses to remove surplus gaseous reactants and reaction byproducts from the chamber.” This teaches that nitrogen OR argon gas is used to purge the vacuum chamber. There is no teaching of simultaneous flowing of BOTH nitrogen and argon gases into the vacuum chamber nor of the use of these two gases in depositing the hafnium nitride layer. There would be no motivation for one skilled in the art to purge the reaction chamber with both nitrogen and argon gases as one of the gases would sufficiently purge the chamber. Thus, it is respectfully submitted that depositing a hafnium nitride layer comprising flowing Nitrogen and Argon atoms into a chamber simultaneously wherein said chamber contains said substrate and a hafnium target, as claimed in amended Claim 8, is not taught or suggested by Haukka et al or Kraus et al or their combination.

Furthermore, with regard to Claim 14, the Examiner states that the combination of Haukka and Kraus discloses impurity doping into the hafnium nitride layer 112 to tune the work

function of the gate electrode. The Examiner refers to paragraph 0036 of Haukka et al.

Applicants could not find in that paragraph or surrounding paragraphs any disclosure of impurity doping into the hafnium nitride layer 112 or any teaching of tuning the work function of the gate electrode.

Claim 24 claims depositing a hafnium nitride layer comprising flowing Nitrogen and Argon atoms into a chamber simultaneously wherein said chamber contains said substrate and a hafnium target. As discussed above, this is not taught or suggested by Haukka et al or Kraus et al or their combination. Claims 26 and 27 depend on Claim 24, which is believed to be patentable over the combination of references as discussed above. It is believed that dependent Claims 26 and 27 are patentable as well for at least the same reasons.

Claims 35 claims depositing a hafnium nitride layer comprising flowing Nitrogen and Argon atoms into a chamber simultaneously wherein said chamber contains said substrate and a hafnium target. As discussed above, this is not taught or suggested by Haukka et al or Kraus et al or their combination. Claims 37 and 39 depend on Claim 35 and Claim 58 depends on Claim 24, both of which are believed to be patentable over the combination of references as discussed above. It is believed that dependent Claims 37, 39, and 58 are patentable as well for at least the same reasons. Furthermore, Claims 39 and 58 claim impurity doping into the hafnium nitride layer to tune the work function of the gate electrode. As discussed above, Applicants could not find in in Haukka et al any disclosure of impurity doping into the hafnium nitride layer 112 or any teaching of tuning the work function of the gate electrode.

Reconsideration of the rejection under 35 U.S.C. 103(a) of Claims 8-9, 14, 24, 25-27, 35, 39, and 58 as being unpatentable over Haukka et al in view of Kraus et al is requested in view of amended Claim 8 and in accordance with the remarks above.

Reconsideration of the rejection under 35 U.S.C. 103(a) of Claims 10, 12, 15, 54, 56, and 59 as being unpatentable over Haukka et al in view Kraus et al and further in view of Optimum range is requested in view of amended Claim 8 and in accordance with the following remarks.

Claims 10, 12, and 15 provide further detail about Claim 8. Claims 54, 56, and 59 provide further detail about Claim 24. As discussed above, depositing a hafnium nitride layer comprising flowing Nitrogen and Argon atoms into a chamber simultaneously wherein said chamber contains said substrate and a hafnium target, as claimed in amended Claim 8 and in Claim 24, is not taught or suggested by Haukka et al or Kraus et al or their combination. Thus, it is believed that Claims 8 and 24 are patentable over the combination of references and their dependent claims are patentable as well.

Reconsideration of the rejection under 35 U.S.C. 103(a) of Claims 10, 12, 15, 54, 56, and 59 as being unpatentable over Haukka et al in view Kraus et al and further in view of Optimum range is requested in view of amended claim 8 and in accordance with the remarks above.

Reconsideration of the rejection under 35 U.S.C. 103(a) of Claims 11 and 55 as being unpatentable over Haukka et al in view of Kraus et al and further in view of Kubota et al is requested in view of amended Claim 8 and in accordance with the following remarks.

Claims 11 and 55 provide further detail about independent Claims 8 and 24, respectively. As discussed above, depositing a hafnium nitride layer comprising flowing Nitrogen and Argon atoms into a chamber simultaneously wherein said chamber contains said substrate and a hafnium target, as claimed in amended Claim 8 and in Claim 24, is not taught or suggested by Haukka et al or Kraus et al or their combination. Thus, it is believed that Claims 8 and 24 are patentable over the combination of references and their dependent claims are patentable as well.

Reconsideration of the rejection under 35 U.S.C. 103(a) of Claims 11 and 55 as being unpatentable over Haukka et al in view of Kraus et al and further in view of Kubota et al is requested in view of amended Claim 8 and in accordance with the remarks above.

Reconsideration of the rejection under 35 U.S.C. 103(a) of Claims 40-43 and 45-46 as being unpatentable over Eppich et al in view of Haukka et al is requested in accordance with the following remarks.

It is agreed with the Examiner that Eppich et al fails to teach depositing the second metal capping layer comprising flowing Nitrogen and Argon atoms into a chamber simultaneously wherein the chamber contains the substrate and a hafnium target to form the hafnium nitride layer. As discussed above, it is not agreed that Haukka et al teach simultaneously flowing Nitrogen and Argon atoms into a chamber wherein the chamber contains the substrate and a hafnium target to form the hafnium nitride layer. Haukka et al teaches in paragraph [0038], lines 18-24: "Gas phase-reactions between precursors and any undesired reactions of byproducts are inhibited because material pulses are separated from each other by time and the reaction chamber

is purged with an inactive gas (e.g. nitrogen or argon) between material pulses to remove surplus gaseous reactants and reaction byproducts from the chamber.” This teaches that nitrogen OR argon gas is used to purge the vacuum chamber. There is no teaching of simultaneous flowing of BOTH nitrogen and argon gases into the vacuum chamber nor of the use of these two gases in depositing the hafnium nitride layer. There would be no motivation for one skilled in the art to purge the reaction chamber with both nitrogen and argon gases as one of the gases would sufficiently purge the chamber. It is respectfully submitted that depositing a hafnium nitride layer comprising flowing Nitrogen and Argon atoms into a chamber simultaneously wherein said chamber contains said substrate and a hafnium target, as claimed in Claim 40, is not taught or suggested by Eppich et al or Haukka et al or their combination. Thus, Claim 40 is believed to be patentable over the references. Dependent claims 41-43 and 45-46 are believed to be patentable as well for at least the same reasons. Furthermore, Claim 46 claims impurity doping into the hafnium nitride layer to tune the work function of the gate electrode. As discussed above, Applicants could not find in in Haukka et al any disclosure of impurity doping into the hafnium nitride layer 112 or any teaching of tuning the work function of the gate electrode.

Reconsideration of the rejection under 35 U.S.C. 103(a) of Claims 40-43 and 45-46 as being unpatentable over Eppich et al in view of Haukka et al is requested in accordance with the remarks above.

Reconsideration of the rejection under 35 U.S.C. 103(a) of Claim 47 as being unpatentable over Eppich et al view of Haukka et al and further in view of Optimum range is requested in accordance with the following remarks.

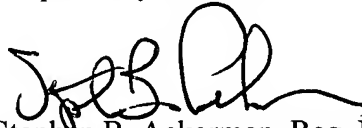
Claim 47 provides further detail about independent Claim 40. As discussed above, depositing a hafnium nitride layer comprising flowing Nitrogen and Argon atoms into a chamber simultaneously wherein said chamber contains said substrate and a hafnium target, as claimed in Claim 40, is not taught or suggested by Eppich et al or Haukka et al or their combination. Thus, it is believed that Claim 40 is patentable over the combination of references and its dependent claim 47 is patentable as well.

Reconsideration of the rejection under 35 U.S.C. 103(a) of Claim 47 as being unpatentable over Eppich et al view of Haukka et al and further in view of Optimum range is requested in accordance with the remarks above.

Allowance of all Claims is requested.

It is requested that should Examiner Kim not find that the Claims are now Allowable that the Examiner call the undersigned at 845 4525863 to overcome any problems preventing allowance.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Stephen B. Ackerman', with a stylized flourish at the end.

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